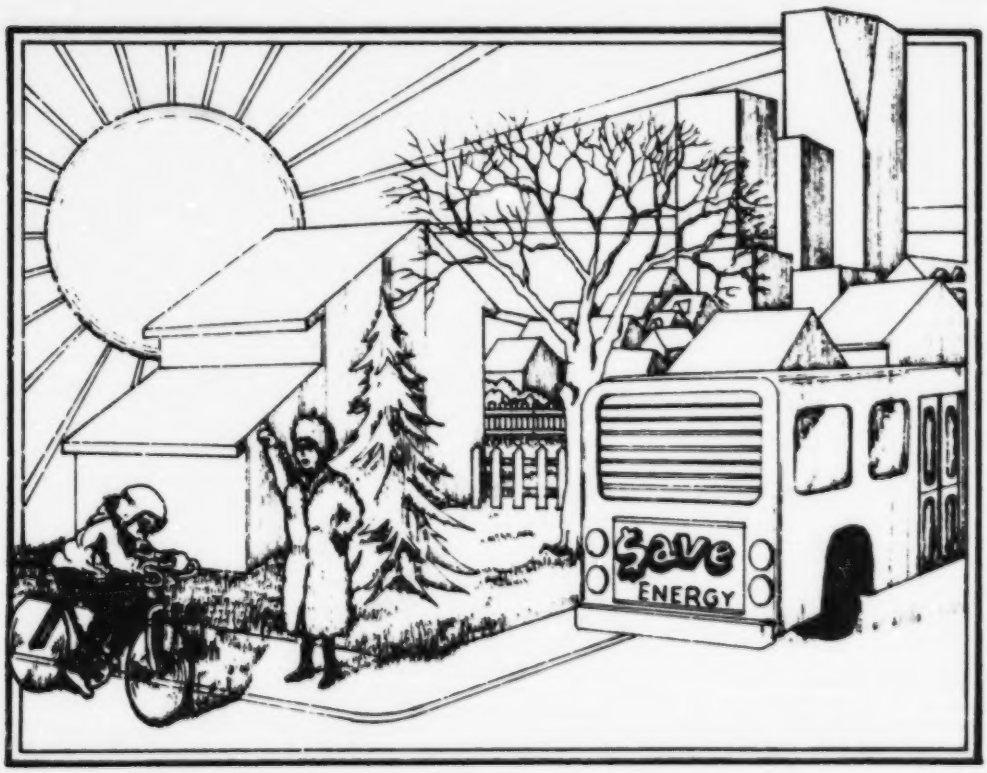
Energy Efficient Community Development
- Interim Report -

THE OPPORTUNITIES FOR CONSERVING ENERGY



City of Regina Planning Department

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Energy Efficient Community Development

Interim Report: The Opportunities for Conserving Energy

City of Regina
Planning Department
September, 1985

Acknowledgement

Special Thanks are extended to Louise M. Beaudry for the use of her Honours Thesis in Geography entitled *An Energy Profile for the City of Regina* from which the energy profile information contained in this report was adopted.

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1.0 INTRODUCTION:

1.1 Background

On March 4, 1985 City Council approved the Terms of Reference for a study on Energy Efficient Community Development. The study is to "explore the opportunities available to improve the energy efficiency of the community, and develop appropriate standards and policies for inclusion in the Development Plan and other relevant bylaws".

This is the first of two interim reports on Energy Efficient Community Development which will be submitted to the Regina Planning Commission prior to the presentation of the final report in the early part of 1986.

There are several reasons why consideration is being given at this time to developing policies to improve the energy efficiency of the community. Most important of these is the fact that energy costs are continuing to increase at a faster rate than the average household's ability to pay for it. Although energy resources appear to be sufficient to meet future demand, the most readily accessible and cheapest energy is quickly becoming depleted. In the future, more reliance will be placed on energy which is difficult and expensive to retrieve, with a resulting increase in the real cost of energy. Thus, the energy consuming characteristics of what we are now building will become increasingly significant over time. We have an opportunity to ensure that the city which we are continuing to build is efficient in its use of energy.

The Planning Department is now reviewing several major elements of the Development Plan including future development of the suburban growth sectors, and inner city revitalization. The form of development which results from the policies and standards developed

for these areas will affect energy consumption through such factors as orientation of lots to achieve passive solar heat gains, average work trip distances, residential densities and road configurations which are designed to support public transit. Considerations of energy efficiency can most effectively be addressed as an integral part of planning for growth in suburban or inner city areas, rather than as a separate exercise wherein many of the best opportunities to establish an energy efficient urban form may be preempted.

1.2 Purpose

The purpose of this first interim report on energy efficient community development is to:

a) Identify potential opportunities for energy conservation that can be undertaken through planning and development activity;

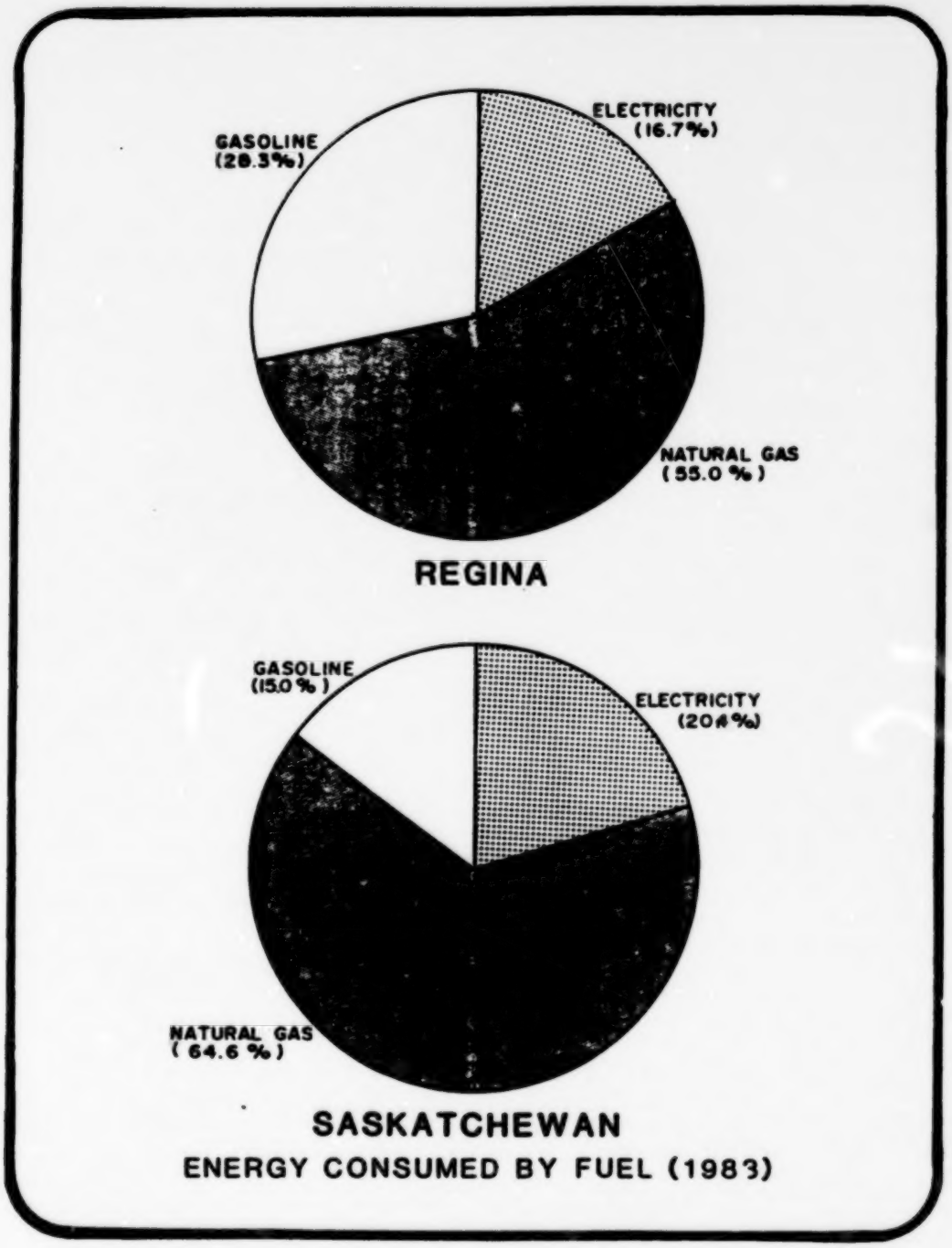
b) Serve as the basis for discussions with the development community and other interested parties regarding energy efficient community development; and,

c) Provide input into consideration being given to alternative planning strategies for the Regina Development Plan Review.

Following this report will be a second interim report scheduled for December, 1985 which will discuss the costs and benefits associated with the various energy conservation opportunities which have been identified. The costs and benefits will be determined through ongoing review and consultation with the development community and other interested parties.

It is not the intention of this interim report to provide definitive conclusions regarding measures taken to conserve energy through land use planning. Rather, the purpose is to reveal a range of opportunities as the basis for discussions, through which conclusions can ultimately be drawn as the study proceeds.

FIGURE 1



Source: Beaudry, L., An Energy Profile for the City of Regina, unpublished Honours Thesis, University of Regina, 1985.

2.0 REGINA'S ENERGY CHARACTERISTICS

2.1 Regina's Energy Profile:

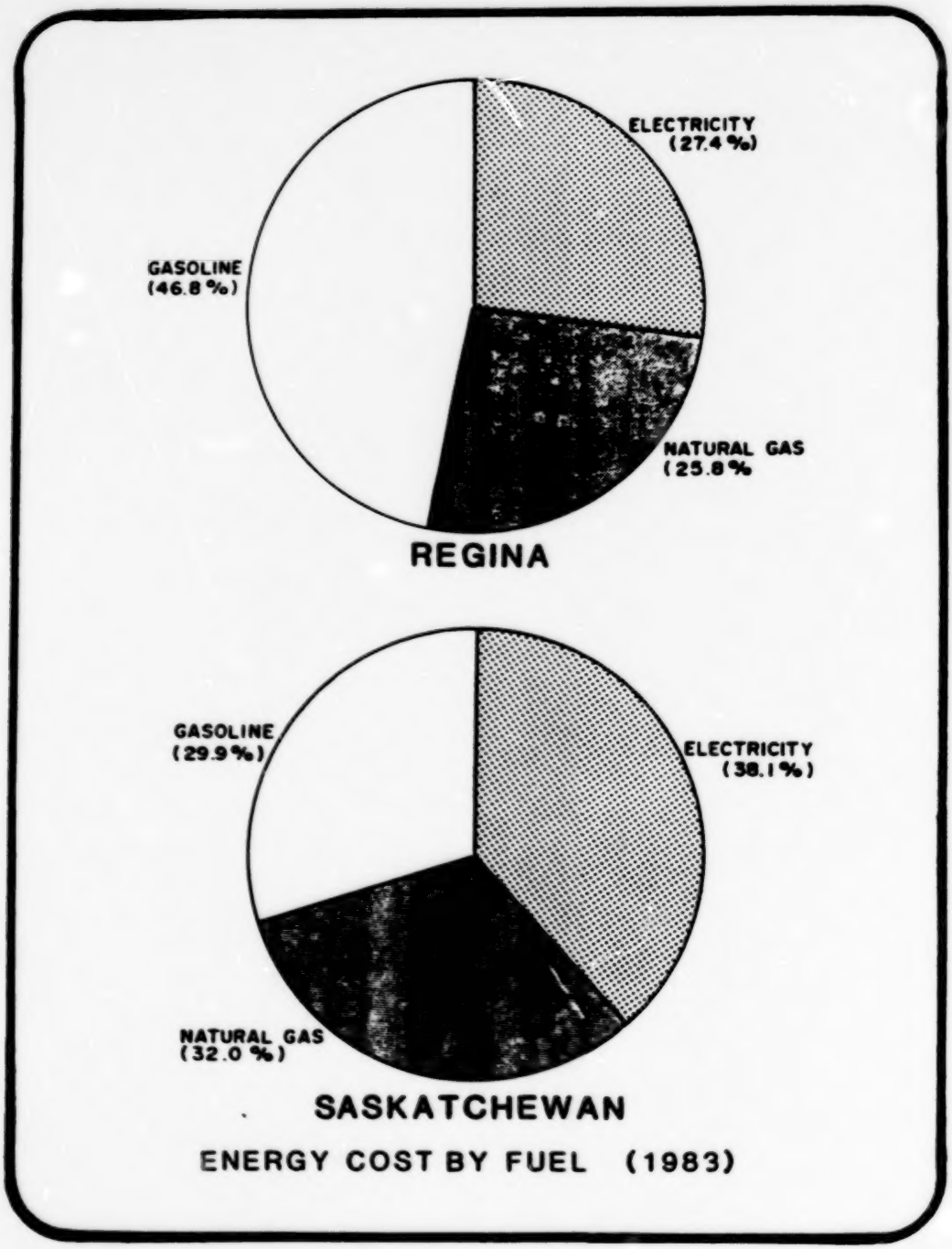
An energy profile is a statement of how energy is used in the community. It includes measures of the various energy sources (natural gas, electricity, gasoline) and the end use of the energy (transportation, industrial, commercial, residential). The profile is used to identify those areas where the greatest energy savings can be achieved and consequently, where the focus of attention should be directed.

2.1.1 Energy Sources: The three major energy sources used in Regina are natural gas, electricity and gasoline. Figure 1 shows the percentage of total energy derived from each of these sources. Natural gas is the most important source of energy in Regina, followed (in order) by gasoline and electricity. Provincially, natural gas is also the largest energy source but electricity is the source of more energy than gasoline.

There are significant variations in the cost of the different energy sources. Gasoline is the most expensive (per unit of energy derived) while natural gas is the cheapest. Consequently, when energy costs are examined, as shown in Figure 2, it can be seen that gasoline accounted for the largest proportion of total energy expenditures, followed by electricity. Natural gas, although providing 55% of the energy used in Regina, accounted for only 25.8% of energy expenditures.

It is interesting to note that gasoline amounted to 46.8% of total energy expenditures in Regina, which is much higher than the total for the Province, which was 29.9% The figures given for gasoline do not, due to the limitations of data availability, include diesel fuel. Gasoline expenditures would likely hold a significantly higher share in Saskatchewan if diesel fuel was considered.

FIGURE 2



Source: Beaudry, L., An Energy Profile for the City of Regina, unpublished Honours Thesis, University of Regina, 1985.

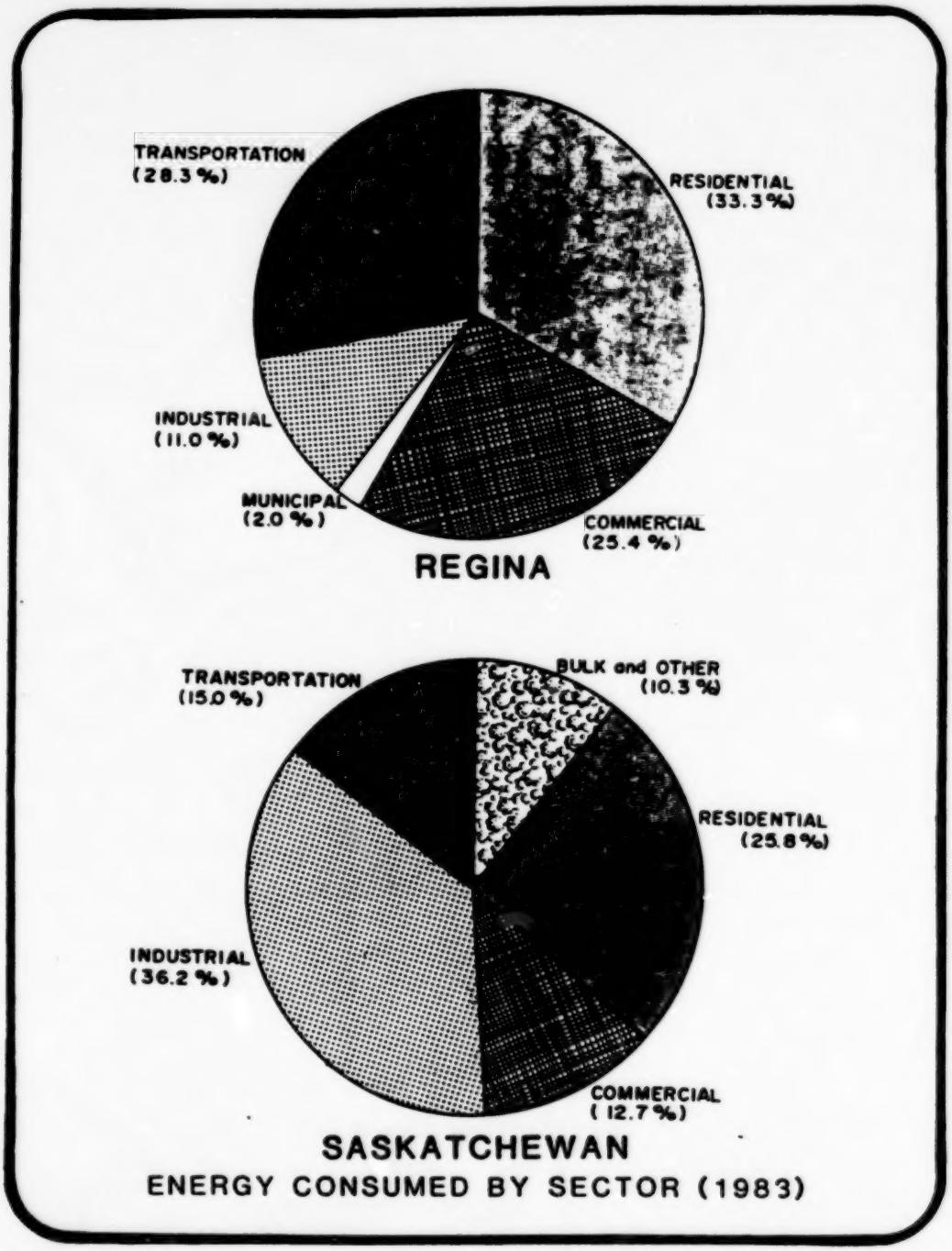
The data collected by type of fuel suggests that attention should be directed toward reducing space heating requirements and other conservation techniques for reducing natural gas demand. The individual consumer living in Regina would likely be interested in reducing his gasoline expenses, which comprise the single largest percentage of his total energy expenditures.

2.1.2 Energy Consumed by Sector: Figure 3 shows the energy consumption in Regina and Saskatchewan for 1983, in each of the major consuming sectors; residential, commercial, industrial, transportation, and municipal. The residential sector consumed the largest percentage of energy-33.3% in Regina, as compared to 25.8 % for the Province. The transportation sector accounted for 28.3% of Regina's total but only 15.0% of Saskatchewan's total.

The percentage of energy consumed by the commercial sector was 26.4% while that of the Province was only 12.7% Since Regina is a government centre, the consumption of energy in the commercial sector (which includes government offices) is relatively high. The industrial sector accounts for only 11.0% of Regina's total energy use, as compared with 36.2% for the Province. The industries located in the North Regina Industrial Subvision (including IPSCO) are not included in Regina's energy total, which may distort this percentage. It should also be noted that energy used in agriculture is included in the industrial category.

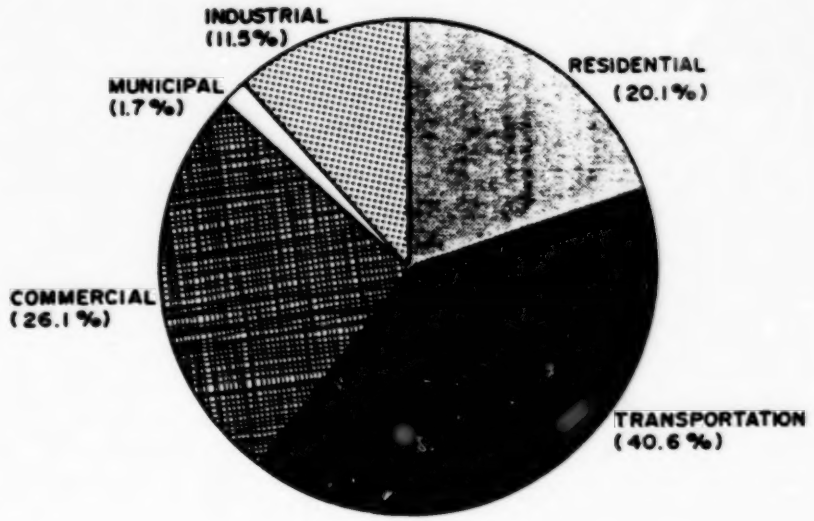
The energy cost by sector (Figure 4) shows that the percentage share held by the commercial, municipal and industrial sectors closely resembles their percentage share of consumption. However, the transportation sector has a significantly higher cost percentage (40.6) as compared with its consumption percentage (28.3). This implies that the consumer can benefit significantly by decreasing his travel by automobile.

FIGURE 3



Source: Beaudry, L., An Energy Profile for the City of Regina, unpublished Honours Thesis, University of Regina, 1985.

FIGURE 4



REGINA

ENERGY COST BY SECTOR (1983)

Source: Beaudry, L., An Energy Profile for the City of Regina, unpublished Honours Thesis, University of Regina, 1985.

TABLE 1 HEATING DEGREE DAYS (HDD), COOLING DEGREE DAYS (CDD) AND HOURS OF SUNSHINE REGINA, SASKATOON, 1983

	a) Regina			b) Saskatoon
MONTH	H.D.D. (18 C base)	C.D.D. (18 C base)	SUNSHINE (hours)	H D.D. (18 C base)
January	912.1	0.0	69.2	950.7
February	762.8	0.0	94.2	771.9
March	752.2	0.0	88.3	745.8
April	452.0	0.0	263.6	442.7
May	277.2	0.9	274.4	281.4
June	86.9	20.5	275.8	75.9
July	15.2	75.0	346.9	16.3
August	8.8	122.9	328.8	11.6
September	240.0	8.2	160.2	240.5
October	372.7	0.0	186.0	385.1
November	622.7	0.0	57.4	620.7
December	1227.6	0.0	88.7	2170.2
TOTALS:	5730.2	227.5	2233.5	5812.8

Source: a) Environment Canada, 1983, pp. 1-5
b) Saskatoon Weather Office, May, 1985

2.2 Climatological Factors

A major determinant of energy use in Regina is the local climate which plays a large role in the amount of energy consumed in space heating and cooling. Because of the extreme cold winter and hot summer conditions, space heating and cooling consumes a significant amount of energy.

The measure which describes the impact of the weather on a dwelling's energy requirements is Heating Degree Days (HDD). It is defined (for a single day) as the number of degrees the daily mean temperature drops below 18° ($65^{\circ}F$). Cooling Degree Days (CDD) is a related measure which is defined (for a single day) as the number of degrees the temperature rises above $18^{\circ}C$. Table 1 shows that Regina's total heating requirements far outweigh its total cooling requirements. Regina's HDD are lower than Saskatoon's HDD, suggesting that Regina's space heating requirements were less than Saskatoon's in 1983. However, HDD's can vary significantly between years, as noted in comparing the HDD for Regina in 1983 (5,730.2) with its HDD for 1982 (6,529.4).

A second important climatic consideration is the amount of solar energy received, which can be measured by the hours of sunshine. This is significant if the application of active and passive solar heating/cooling systems within the community is considered. A typical house receiving direct sunlight in the winter can receive "free heat" comprising 10% to 50% of its total heat load. This can be a considerable saving on heating energy costs, and will be discussed further in Section 5.1 of this report.

2.3 Future Growth Trends

Over the past fifteen years, Regina's population has increased by approximately 26%. According to the most recent Planning Department projections, it is expected to increase by an additional 24% over the next fifteen years so that the population in 2001 will be 219,000. Most of this increase in population is expected to be accommodated in newly developed areas in the Southeast and Northwest Sectors of the City. By the year 2001, it is probable that more than one-third of Regina's housing stock will have been built after 1985. Similar trends in growth can be expected for commercial and industrial development.

This new development will have characteristics that will significantly influence the energy efficiency of the community. Certain trends experienced in Regina in the past suggest that, if continued, will lead to an increase in energy efficiency. For example, the percentage of multiple units (duplexes, townhouses, and apartments, has increased steadily over time, from 23.9% of units existing in 1967 to 30.6% of units existing in 1981. Multiple units accounted for more than 36% of new housing built between 1961 and 1981. Multiple units are inherently more energy efficient due to their high floor area to outside surface area ratio, and can achieve savings in heating of as much as 25% on a per unit/area basis as compared with detached dwellings.

Other trends have tended to reduce the energy efficiency of the community. In 1961, there was one passenger automobile for every 4.9 persons, but by 1981 the number of automobiles had soared in relationship to the population, so that there was one car for every two people living in Regina. This is reflected in the mileage driven and gasoline consumed in transportation for work, shopping and recreational trips.

It is these characteristics of growth which can be addressed through planning to result in the most energy efficient form for new development.

2.4 Areas of Potential Intervention

Planning at the municipal level, while taking into account many social, technological and economic considerations, carries out its objectives by dealing primarily with four basic areas of physical development-the bulk and location of buildings on a site, the use of land and buildings, the accompanying physical infrastructure which the city provides, and the subdivision of land. The opportunity for planners to intervene in the development of the city to improve energy efficiency is therefore largely limited to several key areas:

a) Energy used in the movement of people through the distribution of land uses, the distances separating origins and destinations, and the alignment of roads linking them.

b) The structure of the City in relation to the relative ease with which movement can be accommodated by transit, walking and automobile.

c) The protection of solar access to buildings through the size and configuration of lots and the placement and bulk of the buildings on the lots.

The remainder of this interim report will discuss the potential range of measures that can be used to promote energy efficiency through planning activity. It has been divided into three chapters; energy used in the work trip, energy used in shopping and recreational trips, and energy used in residential space conditioning (heating and cooling).

3.0 CONSERVING ENERGY IN THE WORK TRIP

The daily trip to and from work consumes a significant proportion of the total amount of energy used for transportation in urban areas. Several studies have shown that the work trips can consume as much as 80% of the energy used for urban transportation. Planning can have an influence on energy used in the work trip by minimizing average work trip lengths and by encouraging a shift to more energy efficient transportation modes.

3.1 Average Work Trip Lengths

At the present time, approximately 82,000 Reginans work outside their homes. Although no precise information for Regina on work trip distances exists, one estimate, based on the distribution of population and employment nodes in the city suggests that the average daily round trip length may be 13.5km per capita for a total of 1.1 million km per day. As the city continues to grow in area and as work places remain centralized in the downtown, the industrial sector, and Wascana Park, it is inevitable that average daily round work trip distances will increase as more and more residents are located further from their places of work. Planning can influence the rate at which average travel distances increase in four basic ways.

First, average travel distances can be reduced by encouraging a more compact urban form. This increases the likelihood that workers will live closer to their work places. A more compact urban form implies a higher density of development. Density can be increased in several ways such as reducing the proportion of land dedicated to roads and open space, discouraging "leapfrog" development which leaves intervening vacant lands, favoring the continued development of higher density housing forms such as townhouses, apartments, zero lot line housing, and planned groups of dwellings, and by promoting infill redevelopment to make the best use of valuable inner city and older suburban areas in which the original building forms are becoming obsolete.

Second, average travel distances can be reduced by allocating different residential densities in such a way that the highest densities are located closest to the employment centres; in practical terms, in the area near the downtown and along arterial roads leading to the core. In this way, the greatest number of people are located as near as possible to their work place. At the present time, the census tracts near the downtown have the highest densities, but the population of these areas has been declining. It is warranted from an energy efficiency viewpoint to attempt to reverse this trend by encouraging redevelopment of vacant infill sites at relatively high densities, while ensuring that the amenity of the neighbourhoods is enhanced to attract the needed population base. In new developing areas, the higher density development should be allocated on or near major arterial roads, especially those that lead to employment centres, at a point closest to the employment centre.

Third, average travel distances can be minimized by aligning roads such that they provide as direct a route as possible between the employee's residential "origin" and his work "destination". This applies on a large scale in the alignment of major arterial roads, and on a smaller scale in the design of local and collector streets within subdivisions. An indirect route can quite easily double the actual travel distance and consequent energy consumption.

Finally, employment areas can be located so as to minimize the average travel distance for employees. Although this appears to imply the development of many local employment nodes, it has been the experience of other municipalities that employees do not necessarily live close to their place of work. Consequently, the scattering of employment nodes may actually increase average work trip travel distances, especially where there is little traffic congestion, which would encourage employees to live closer to their work place.

There are a number of specific measures which can be considered in an effort to minimize average work trip lengths:

3.1.1 Avoid Leapfrog Development: The growth of the city should follow a logical progression from the centre outward, avoiding "leapfrog" development which leaves intervening vacant lands. This has been done for the most part in Regina, and is a policy which should be continued.

3.1.2 Develop Areas Closest to Core: New development should occur in the area closest to the core. Regina is developing a linear form on a northwest-southeast axis while industrial lands and the airport areas, which are closer to the core, remain undeveloped. Consideration could be given to limiting the arc of the industrial "wedge" and reviewing the long term location of the airport. The average work trip distance for residents living in these areas would be significantly less than for those living in areas which comprise a further extension of development to the southeast or northwest.

3.1.3 Increase Net Residential Densities: Net residential densities can be increased by encouraging smaller average lot size, more multi-family developments, or some combination of the two. This may be difficult to promote if such developments run counter to prevailing market trends, since there are costs associated with higher density (in terms of a decrease in some amenities) that are borne entirely by the individual owner, while the benefits (in terms of energy savings by reducing travel distances) accrue largely to the residents of future and further outlying developments. However, the Development Plan does contain policies relating to higher density for reasons other than energy savings, and it is worthwile to note that those policies are consistent with good energy practices.

3.1.4 Reuse Buildings: Adaptive reuse of underutilized warehouse and other buildings which have outlived their original purpose should be encouraged. Included in this strategy should be the redevelopment of closed schools and the vacated rail yards.

3.1.5 Eliminate Lanes: Rear lanes should generally be eliminated in new residential development as a means of increasing density.

3.1.6 Reduce Road Dedication: The proportion of land dedicated to roads could be reduced by careful design of subdivisions to minimize the length of road provided, and by reducing right-of-way width standards in conjunction with eliminating some sidewalks and obtaining front yard easements for services and tree planting.

3.1.7 Innovative Culs-de-sac Designs: The innovative use of narrow culs-de-sac can increase residential densities while maintaining lot size, by reducing the amount of standard size frontage road needed to serve the lots.

3.1.8 Deeper Lots: Narrower, deeper lots should be favored over wider, shallower lots as a method of minimizing the amount of land dedicated to roads.

3.1.9 Reduce Open Space Dedication: Consideration can be given to reducing the amount of land dedicated to public reserves, and the provision of cash-in-lieu should be encouraged in cases where the land otherwise dedicated would be surplus to the actual needs of the area.

3.1.10 Higher Density Infill Development: Redevelopment of properties in older areas should generally achieve a higher density than was originally established, in recognition of the central location of these areas. Most inner city properties could, under the current zoning, be redeveloped at densities significantly higher than they are now, and this is seen as being positive from an energy viewpoint. However, care should be taken to ensure that higher densities are not achieved at the expense of neighbourhood amenity, as discussed in 3.1.11.

3.1.11 Revitalize Older Neighbourhoods: Older neighbourhoods have declined in population while most of the population growth has been accommodated in new development at the periphery of the city. A strategy to reverse this trend should consider the attractiveness of older areas to a range of demographic groups. School closures, reduced recreational services, intrusion of new major traffic routes, and the encroachment of commercial and industrial development, serve to decrease the attractiveness of older neighbourhoods leading to a population decline and lower densities, thus acting counter to good energy practices.

3.1.12 Housing Conversions: One reason for the decline of population in older neighbourhoods is that housing forms have not kept pace with the change in the composition of families over time (smaller families including more single elderly). Large houses with few occupants can be converted to apartments in order to make better use of the space. Care should be taken in the maintenance of such converted houses, however, to ensure that the attractiveness of the neighbourhood is not adversely affected.

3.1.13 High Density Nodes: In new subdivisions, higher density nodes should be located in appropriate places near the periphery of the area to enhance access to arterial roads, and minimize traffic infiltration through the neighbourhood. The lowest densities of development should generally be located in those areas furthest from arterial roadways.

3.1.14 Apartments on Major Streets: Arterial commercial "strips" in Regina have generally been developed at low densities and contain exclusively commercial uses such as gas stations, restaurants, motels and shopping centres. However, properties on or near arterial roads, especially those leading to major employment centres, are desirable areas from an energy viewpoint in which to locate higher density residential development.

3.1.15 Short, Direct Work Trip Routes: The distance between home and work is affected by the directness of the route taken; the shortest trips being a relatively straight line, and longer trips involving more meandering routes. The motorist is constrained in his work trip route decision by the alignment of various types of roads (collectors, arterials) and thus care should be taken in the design of such work trip carrying roadways so that they proceed as directly as possible from residential "origin" to employment centre "destinations". The south and east parts of Regina are particularly well served with arterial roadways which lead fairly directly to the major downtown employment area (Lewvan/Saskatchewan Drive, Albert Street, Wascana Parkway/Broad Street, Arcola Avenue/Saskatchewan Drive, and Victoria Avenue). The north and northwest areas have fewer choices of direct routes to the downtown (Albert Street, Broad Street, Dewdney Avenue) and those not living near these streets are forced to take a more indirect route, usually involving some backtracking such as on McCarthy Boulevard which "doglegs" away from the downtown rather than toward it. As a consequence, roads which are designed for lower traffic volumes but which happen to provide a more direct route (such as Sherwood Drive/Argyle Street North/Avonhurst) are burdened with high traffic volumes leading to energy wasteful traffic tieups and unnecessary stops and starts. Traffic planning should match the lines of desired travel, from work trip origins to destinations, with the appropriate alignment and classification of road.

3.1.16 Local Street Design: There are several ways in which the design of local crescents, culs-de-sac and P-loops can reduce travel distances. Where there is a choice, local streets should feed into major rather than minor collectors. Access should be at the point on the collector closest to the arterial road leading to the principal employment centre.

3.1.17 Keep Downtown the Major Employment Centre: The location of an employment centre has an obvious influence on travel distances for work trips. In its simplest form it can be readily seen that the provision of many scattered employment nodes make it possible for more residents to live closer to their work places than would be the case with a single, centralized employment node. However, there are several complications which make the situation less clear. Proximity to the work place has been found to be a relatively low factor in most peoples' decision as to where to live. This is even more apparent when more than one family member is working, as is increasingly the case. Consequently, employment centres will likely draw not only on the nearby population, but will have employees who live in all areas of the city. The downtown is the single most accessible location for the city as a whole, and is the appropriate location for businesses which draw on all areas of the city for their work force. Local employment nodes should generally accommodate only small scale operations.

3.2 Modal Choice in Work Trips

There are several different modes by which commuters travel to work in Regina; car, bus, walking and bicycling are, in that order, the most significant ones.

Not all transportation modes are equally efficient in terms of their energy use. Walking and bicycling consume no energy (other than muscle power) while automobiles and buses consume substantial amounts of gasoline, which is the energy source most subject to rapid price increase and future shortages. The efficiency of cars and buses depends on many factors including engine technology, driving conditions, and number of occupants in the vehicle. Walking and cycling, the two "zero energy" modes, are for most Reginans unacceptable for work trips due to the distances travelled and lack of shelter from the weather. Consequently, the automobile and bus will undoubtedly remain the principal means of travel to work.

Planning measures can be introduced to achieve several objectives:

a) Improve the efficiency of buses by encouraging an increase in the number of occupants per bus and arranging land uses, development densities and roadways such that transit routes can be as simple, direct and effective as possible;

b) Ensure that automobiles are used as efficiently as possible by prescribing measures to encourage higher vehicle occupancy and improve traffic flow; and,

c) Encourage the greatest use of walking and bicycling as modes of transportation for work trips.

There are a number of specific measures which can be considered to achieve the above:

3.2.1 High Density Transit Corridors: The alignment of transit routes and the density of development permitted along such routes should be coordinated. The overall planning of neighbourhoods and the city should take into account the desirability of providing high density transit corridors which lead to the downtown and other major employment centres. A higher density of development along transit routes will help ensure that the service is well used, justifying a greater frequency of service, more convenience to transit patrons and a correspondingly greater use of transit as a work trip travel mode. The provision of transit service to dispersed low density areas could be de-emphasized, allowing established targets for ridership to be met on the more efficient routes along high density corridors. In this way, the energy wasteful movement of empty or near empty buses could be reduced.

3.2.2 Express Busways: The provision of express busways would allow for faster trips - a major incentive for increased ridership. Feeder access to the express route could be accommodated by separate bus

routes circulating through neighbourhoods, express buses leaving the express route for a portion of their trip to circulate through neighbourhoods before completing their route, or non-transit feeder systems such as "kiss and ride" drop-offs or "park and ride" services at outlying shopping centres. An express bus corridor will be provided as part of the rail relocation program. If shown to be successful, other opportunities for providing express bus corridors could be considered.

3.2.3 Reduce Walking to Bus Stops: The actual time spent on the bus is only part of the overall trip time for transit patrons. A substantial portion of trip time is utilized walking to and from stops. Since transit ridership is very sensitive to trip time, it is worthwhile to reduce the time spent walking to stops. Consideration should be given in the design of local streets in residential areas to provide sidewalks which are as direct as possible to bus stops. In addition to reducing the actual walking distances, it is equally important to reduce perceived walking distances by minimizing the number of turns and backtracking needed to reach the bus stop.

3.2.4 Improve Bus Waiting Comfort: A major disincentive for transit use is the relative inconvenience and discomfort associated with waiting at bus stops for the next bus to arrive. Passenger comfort can be increased by providing shelters (as are done at many stops) and by posting schedules at the stops in order to reassure patrons of the arrival time of their bus. New telecommunications technology, which enables patrons to determine the "real time" arrival of the next bus could be considered.

3.2.5 Promote Ride Sharing: A survey undertaken by the Planning Department in 1983 showed that half of downtown employees usually drive themselves to work each day, but only about 13% usually get a lift with someone else. On the average, only one vehicle in

four has an occupant other than the driver. There is a tremendous potential for ride sharing to reduce work trip energy consumption by increasing the number of passengers per vehicle, and consequently reducing the number of vehicle miles travelled. Much of the impetus for encouraging ride sharing must come from such non-traditional planning sources as employers helping to organize car pools or van pools, traffic control incentives such as permitting high occupancy vehicles to use the exclusive bus lanes during peak hours, and introducing parking incentives such as preferred locations or reduced rates for high occupancy vehicles. Planning can influence low occupancy travel by addressing the supply of parking to restrict the availablilty of long term parking in the downtown. Care must be taken, however, to ensure that the short term parking supply (for shoppers) remains adequate. Consideration can be given to turning over some parking now used as long term monthly rental space, to short term hourly users.

3.2.6 Improve Traffic Flow: Automobile operation can be made more energy efficient by facilitating trips at uniform moderate speeds with few stops. The use of arterial roadways which can accommodate large numbers of vehicles at relatively high speeds with few stops should be encouraged for work trips. Slower moving local and collector streets should not provide a through route alternative to arterials. Emphasis should be placed on improving the traffic flow of arterial streets by minimizing the number of stops and eliminating bottlenecks. It should also be noted that the higher vehicle occupancy and resultingly fewer vehicles on the road, as discussed in 3.2.5, can help to reduce congestion and thus permit the more efficient operation of vehicles. Staggering work hours, although not within the purview of planning, is nevertheless worth mentioning as a way in which peak traffic congestion can be significantly reduced or eliminated.

3.2.7 Bicycle to Work: Climate virtually prohibits bicycle use for work trips during the four or five winter months each year, but it is a possible travel mode during the remainder of the year. A survey of bicycle riders conducted by the Planning Department in July, 1982 showed that the major concerns of bicyclists include lack of suitable bicycle paths or routes, lack of secure bicycle racks, and physical hazards such as bridges and railway tracks. The survey also showed that almost 75% of bicycle trips to the downtown are work trips, more than 84% of those cyclists are twenty years of age or older (almost 40% are over thirty years old) and almost 85% travel more than two miles to the downtown (almost 70% travel more than three miles). These figures suggest that bicycle use may be made viable to a substantial proportion of downtown commuters during seven-eight months of the year if the concerns noted above can be effectively addressed. The City could undertake physical improvements to facilitate bicycle commuting including widening of curb lanes where feasible, modification of bottlenecks, upgrading street resurfacing on designated routes, providing improved signage, and considering the incorporation of a bicycle path into the busway proposed on the abandoned CNR right-of-way.

3.2.8 Bicycle Parking: A special concern of bicyclists is the adequacy and security of parking, especially in the downtown. The newly adopted Downtown Plan, which suggests that bicycle parking be encouraged in the downtown for bicycle commuters, would help to resolve this concern.

3.2.9 Walking to Work: Distance and climate constrains most Reginans from walking to work downtown-only about 11% of Regina residents live within comfortable walking distance of the downtown, and this proportion is declining as the process of suburbanization continues. The potential for nearby residents to walk downtown, however, is high. Half of all employees who live in the Transitional area walk to work (some portion of the remainder do not walk because they work in Ross Industrial Park, University

of Regina or other outlying employment centres). A strategy to promote residential development within walking distance of the downtown would provide greater opportunity for more people to walk to work, and is also consistent with the density considerations discussed in Sections 3.1.10 to 3.1.12.

3.2.10 Walking Routes: Consideration could be given to identifying "pedestrian commuter" routes to the downtown through inner city neighbourhoods, and a higher level of landscaping and pedestrian amenity be provided along such routes in an effort to make pedestrian commuting more attractive.

3.2.11 Telecommunications: New telecommunications technology is making it possible for more and more work to be done from the home. Since a great deal of energy is expended in moving the individual to his work place, and very little energy is needed to move the ideas or information that is very often the essence of the individuals work, telecommunications can be seen as perhaps the ultimate in energy efficient work trip modes. The implications on activity patterns, social relationships and land use and building form may be profound, and should be examined in some detail so that they may be anticipated and planned for accordingly.

4.0 CONSERVING ENERGY IN SHOPPING AND RECREATIONAL TRIPS

Shopping and recreation trips consume most of the energy used for personal transportation aside from work trips. In spite of Regina's relatively small size, it appears that an inordinate amount of energy is used in these trips, resulting in a total transportation energy usage level which is high, as described in Section 2.1 of this report. Energy used in shopping and recreational trips can be minimized through planning activity in two basic ways.

First, land uses can be allocated in a manner which facilitate combined trips at a single destination - for example, a shopping mall with medical offices and a library. In this way, energy wasteful trips from one destination to another are reduced.

Second, planning can encourage the use of more energy efficient transportation modes. Shopping and recreational uses in neighbourhoods can be located to maximize the number of residents who live within walking distance, and pedestrian routes to neighbourhood facilities can be enhanced to encourage residents to walk rather than drive. Larger neighbourhood or district scale facilities can be located on transit routes to provide an alternative to automobile use for these relatively frequent but short trips.

4.1 Combined Trips

Significant energy savings can be achieved by encouraging combined shopping and/or recreational trips at a single destination which is conveniently reached. Research recently completed in Ottawa suggests the following measures:

4.1.1 Walk to Neighbourhood "Cluster": Local clusters within walking or cycling distance of their "markets" may consist of a church, confectionery store or pharmacy and park/school.

4.1.2 "One Stop "District Centres": Community and district centres serving between 15,000-60,000 persons can combine shopping facilities, banks, medical services, restaurants and compatible employment opportunities such as professional offices.

4.1.3 Highest Order Shopping Downtown: The downtown should provide a complex that serves the inner city for basic needs, and the entire city and region for specialized needs. Uses should include a full range of shopping facilities from the least to most specialized, work places, banks, theatres, concert halls and other cultural facilities, movies, night clubs, restaurants and markets.

4.2 Modal Choice

There are several measures which can be considered in order to facilitate the use of more energy efficient modes of transportation for shopping and recreational trips:

4.2.1 Centrally Located Neighbourhood Facilities: Neighbourhood shopping and recreation facilities such as parks and local shopping should be located in a manner which maximizes the number of area residents who are within comfortable walking or cycling distance.

4.2.2 Walkways to Stores, Parks: Pedestrian pathways (either sidewalks along streets or walkways through blocks) should provide a direct route for area residents to walk to neighbourhood shopping and recreation facilities.

4.2.3 Walking Comfort: Pedestrian pathways to neighbourhood shopping and recreational facilities should be made comfortable to use by considering appropriate levels of lighting, traffic controls at street crossings, and minimizing the number of turns.

4.2.4 Bus Service to Shops: Neighbourhood shopping and recreational facilities, and especially the larger district or regional shopping and recreational facilities that serve the higher order needs of several neighbourhoods, should be located on bus routes that circulate through the areas which they are intended to serve.

5.0 CONSERVING ENERGY IN RESIDENTIAL SPACE CONDITIONING:

Residential space conditioning is a term which includes both home heating and cooling. The residential sector consumes about one-third of the energy used in Regina, most of which is used for space conditioning. Given our climatic extremes, it is not surprising that approximately 27% of Regina's total energy is used for home heating and cooling. This is well above the 16% of total energy which a typical Canadian city uses for the same purpose. Many cities have focused their efforts in conserving energy on measures aimed at residential space conditioning for two basic reasons:

1) the savings can be significant;
2) many of the measures are relatively easy and inexpensive to implement.

It should be noted, however, that the greatest energy savings in residential space conditioning involve measures which lie largely outside the scope of planning-increasing insulation, improving air tightness, installing night setback thermostats, maintaining furnace condition, etc. These types of measures can have a dramatic effect on reducing residential energy consumption, meaning that the planning measures can influence a correspondingly smaller share of energy savings in this area. A recent study in Lethbridge, Alberta showed that, in an area which has a similar climate to Regina, planning measures such as solar orientation can influence energy savings of 6% per year, but the non-planning measures can save 60%-65% per year. The report goes on to state that "in a well insulated and airtight home, the sun may provide up to 25% of the home heating requirements, but the energy required to heat the house in the first place is so low that the cost savings may only amount to a few dollars per year". Nevertheless, solar orientation is of some benefit as long as the considerations of density, transit efficiency and other transportation related measures are not sacrificed in achieving it. As the Lethbridge report concludes, "In the long term, high fuel costs may make even small savings from solar orientation important."

Solar orientation is one, perhaps the most important, measure among several which are available through planning activity to achieve energy savings in space conditioning. Other measures concentrate on reducing heat loss, directed primarily at the bulk of buildings and landscaping.

5.1 Solar Heat Gains

Direct utilization of the sun's energy for home heating is a simple and practical way of reducing the demand placed on gas or electrical energy sources. The two basic elements in utilizing solar heat are orienting lots so that houses may be constructed with predominantly south facing windows, and protecting solar access by restricting overshadowing from other buildings. It is almost as important to restrict solar heat gains in the summer months, in order to reduce energy used for air conditioning. The following measures are intended to achieve a more effective utilization of solar heat:

5.1.1 North-South Oriented Lots: New subdivisions should provide for as many lots as possible to be oriented on a north-south axis. The simple expedient of providing south facing windows can reduce heating costs considerably by utilizing the sun's energy directly in heating the home. Research undertaken in Brampton, Ontario suggests that a divergence of 12 to 15 degrees from a true north-south orientation is an acceptable range for effective solar orientation. Development undertaken on flat terrain with few design constraints can reasonably be expected to achieve 80% or more of lots oriented within 15 degrees of north-south. This can be a target for future developments in areas where concept plans have not been approved (concept plans may impose design constraints which make 80% solar orientation difficult to achieve; and thus care should be taken in future concept plans to avoid such constraints). In areas where existing development or concept

plans are in place, no specific targets can be assigned, but experience in reviewing subdivision plans in Regina has shown that 60% to 80% solar orientation can very often be achieved by careful design of local streets and lots.

5.1.2 North-South Oriented Houses: Where north-south orientation of lots is not possible, it may still be possible to site a house to maximize solar heat gain by skewing it on the lot. Relaxations of side yards which may be necessary to accommodate such a measure should be considered as part of the zoning regulations.

5.1.3 Houses on Slopes: Lots on east or west slopes can permit (perhaps even benefit from) divergence from a north-south orientation. On east slopes, streets should run southeast-northwest, while on west slopes, streets should run southwest-northeast. This minimizes the overshadowing of houses on each other.

5.1.4 Deeper Lots: The provision of narrower, deeper lots increases the separation between rows of houses, thus reducing overshadowing. This measure is also consistent with increasing density as described in Section 3.1.8.

5.1.5 Solar Access: Consideration could be given to prescribing solar building "envelopes", the area within which building may occur without overshadowing neighbouring properties.

5.1.6 Uniform Setbacks: Uniform setback of houses will reduce overshadowing of one on the other.

5.1.7 South Facing Windows: Although not within traditional planning jurisdiction, consideration could be given to ways in which south facing windows on houses can be encouraged. In conjunction with the above, appropriate overhangs or awnings should be provided to shield south windows from summer sun. (This occurs since the sun is much higher in the sky during the summer). West windows, those that absorb most solar heat gains in the summertime, but not in the winter, should be minimized.

5.1.8 Active Solar Systems: Given the present level of technology, active solar systems (photovoltaic panels or hot water systems) have not proven economical in the Regina context. However, as technology improves and traditional energy sources increase in real cost, active systems may become more practical, and possible zoning impediments to their use should be reviewed.

5.2 External Heat Loss

The fact that buildings lose heat to the outside through walls and roofs is the reason that heating systems are required. In a perfectly insulated house, all of the heating needs could be met through incidental heat sources, such as lights, refrigerator motors, stoves, etc. Consequently, reducing external heat loss can have a profound impact upon the energy needed specifically for heating and could theoretically be reduced to zero (as has been done in some "superinsulated" demonstration houses). Most of the measures for reducing external heat loss lie outside the scope of planning; insulation, air tightness, etc. There are however, several planning measures which can influence heat loss, as discussed below:

5.2.1 Wind Protection: Winds increase the rate of heat loss from the external shell of buildings. By orienting houses 45 degrees to the prevailing winds, resulting heat loss can be reduced by one-half to one-third. The predominant winter wind in Regina is from the northwest, and the secondary wind is from the southeast. Consequently, houses should be oriented on a north-south axis, which ties in with the passive solar heat gain measures described in Section 5.1.

5.2.2 Reduce Outside Walls, Roof Area: Heat is lost primarily through external surface areas - walls and roof. Consequently, a reduction in the external surface area in relation to the internal floor area can achieve greater energy savings by reducing heat loss. This can be achieved by promoting two storey, semi-detached, and townhouse units, which have less outside surface area than a bungalow of the same floor area. The actual energy savings however, would be negligible in airtight superinsulated houses since external heat loss would thus already be minimized.

5.2.3 Insulation: New houses are built to much higher insulation standards than is generally the case for existing housing, especially those of older vintage. As discussed in Section 2.3, housing built from now on may account for one-third of the housing stock Regina will have in 2001, but that still leaves two-thirds of its housing stock which will predate 1985 and be of varying quality in terms of its insulation levels. The City administered Residential Rehabilitation Assistance Program (RRAP) which provides funds for homeowners to upgrade their properties in designated areas, is one vehicle whereby improved weatherstripping, storm windows and doors, etc., can be promoted to reduce heat loss from older houses. The senior levels of Government and Saskatchewan Power Corporation can also be encouraged to maintain and enhance their programs directed at improving the energy efficiency of existing housing.

5.2.4 Landscaping: Trees can be used effectively to screen wind and provide shade as needed. Planting coniferous trees on the north and west sides of houses will block the cold winter winds - the conifers on the west side will also shade summer sun to minimize heat gains during that season. Deciduous trees on the south side will permit sunlight penetration during the winter, and shade during the summer. Landscaping can now be regulated through zoning under the provisions of the Planning and Development Act, 1983.

6.0 CONCLUSION:

Based on the foregoing discussion, it can be concluded that there are a number of measures which can potentially be undertaken through land use planning to conserve energy. Although some preliminary evaluation of the measures has been made, the primary purpose of this report has been to stimulate discussions with affected City departments, the development community, and other interested parties. Through these discussions, a further understanding of the implications of the various measures can be gained, and recommendations will be formulated accordingly in a final report, which is intended to be presented to the Regina Planning Commission and City Council for their approval.

Your written comments should be sent to:

City of Regina,
Planning Department,
9th Floor, City Hall,
P.O. Box 1790,
S4P 3C8

Briefs will be accepted prior to November 15, 1985.

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